

Non-Distorting Phase Rotation Front Ends

R. B. Palmer Version 3

7/12/00

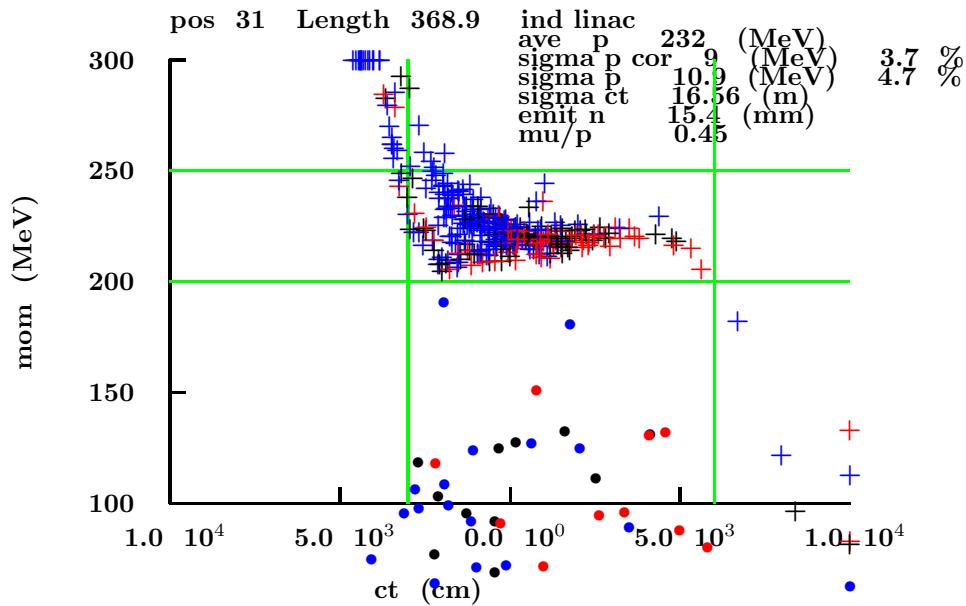
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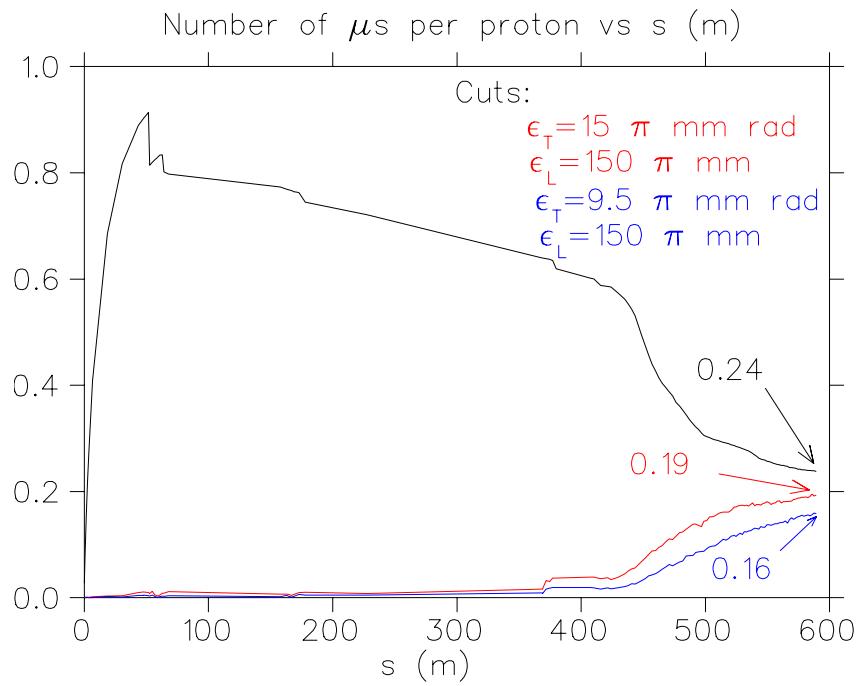
1 c.f. MuTAC Double Phase Rot

for comparison, I show:

Muon distribution at the end of the induction linac, prior to matching into the cooling. The dots are electrons.



Using Greg's analysis and using 100 m rad Hg angle, Juan gets:



2 Non Distorting without minicool(nd2)

2.1 Introduction

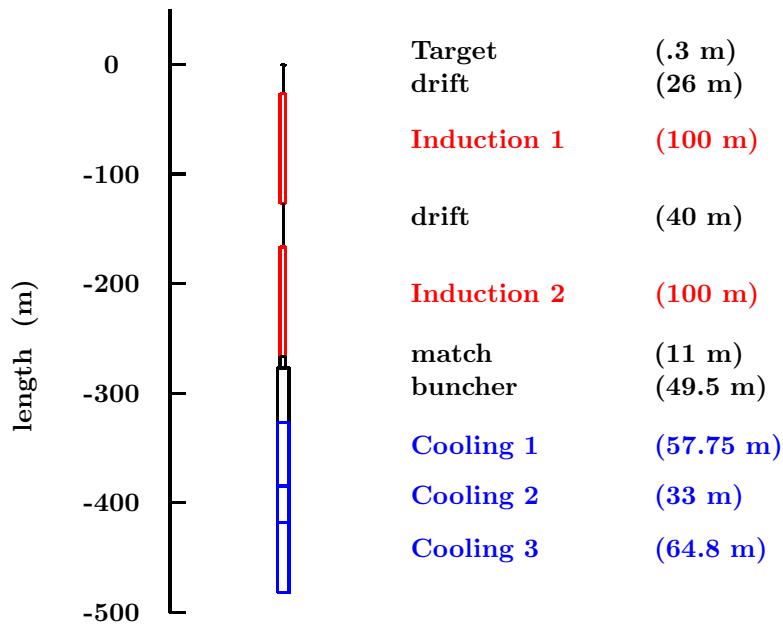
As an initial try I am using

No low frequency RF

No Mini-Cooling

No correlation correction

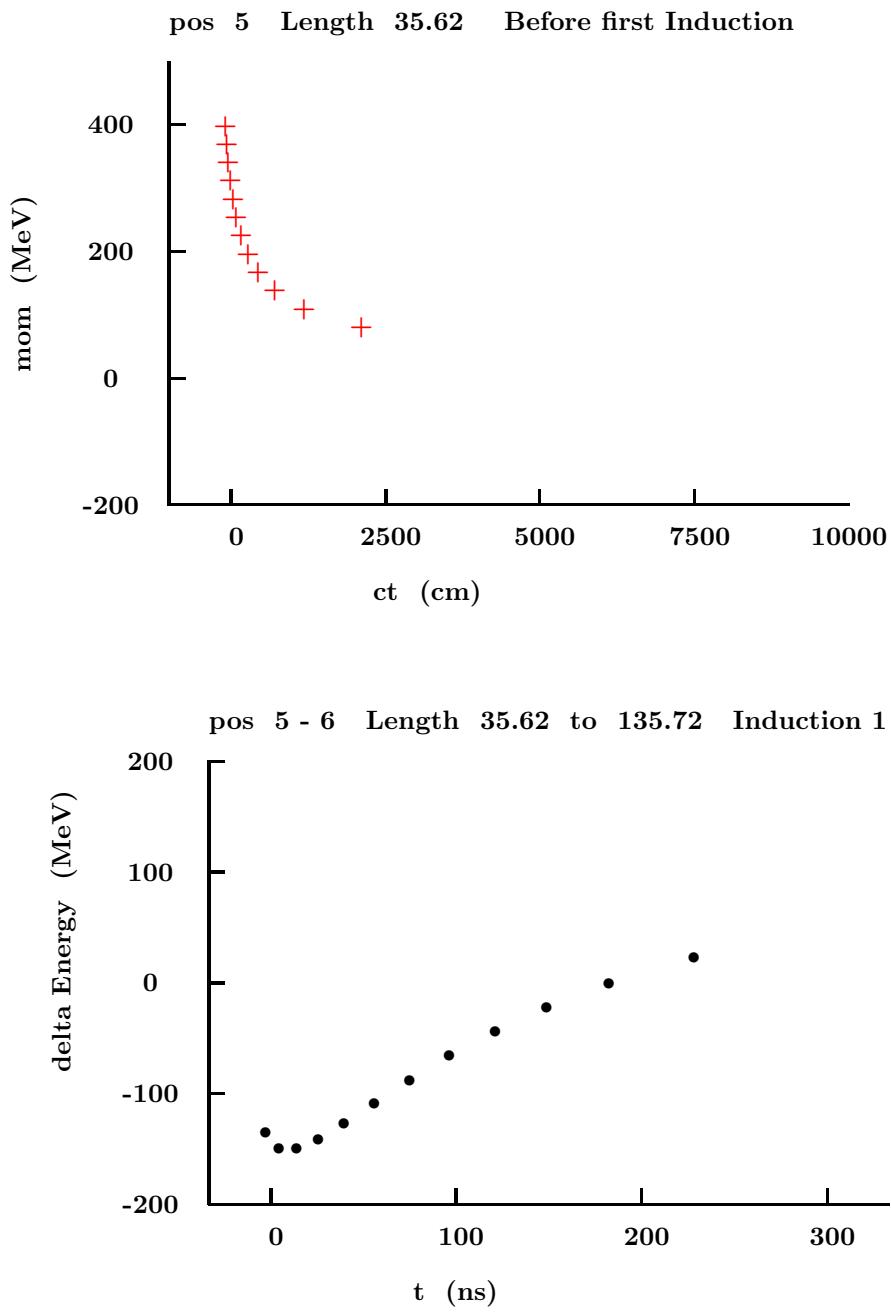
The same cooling as in my MuTAC report; i.e with tapered super FOFO, but no beta matching between different cooling sections.

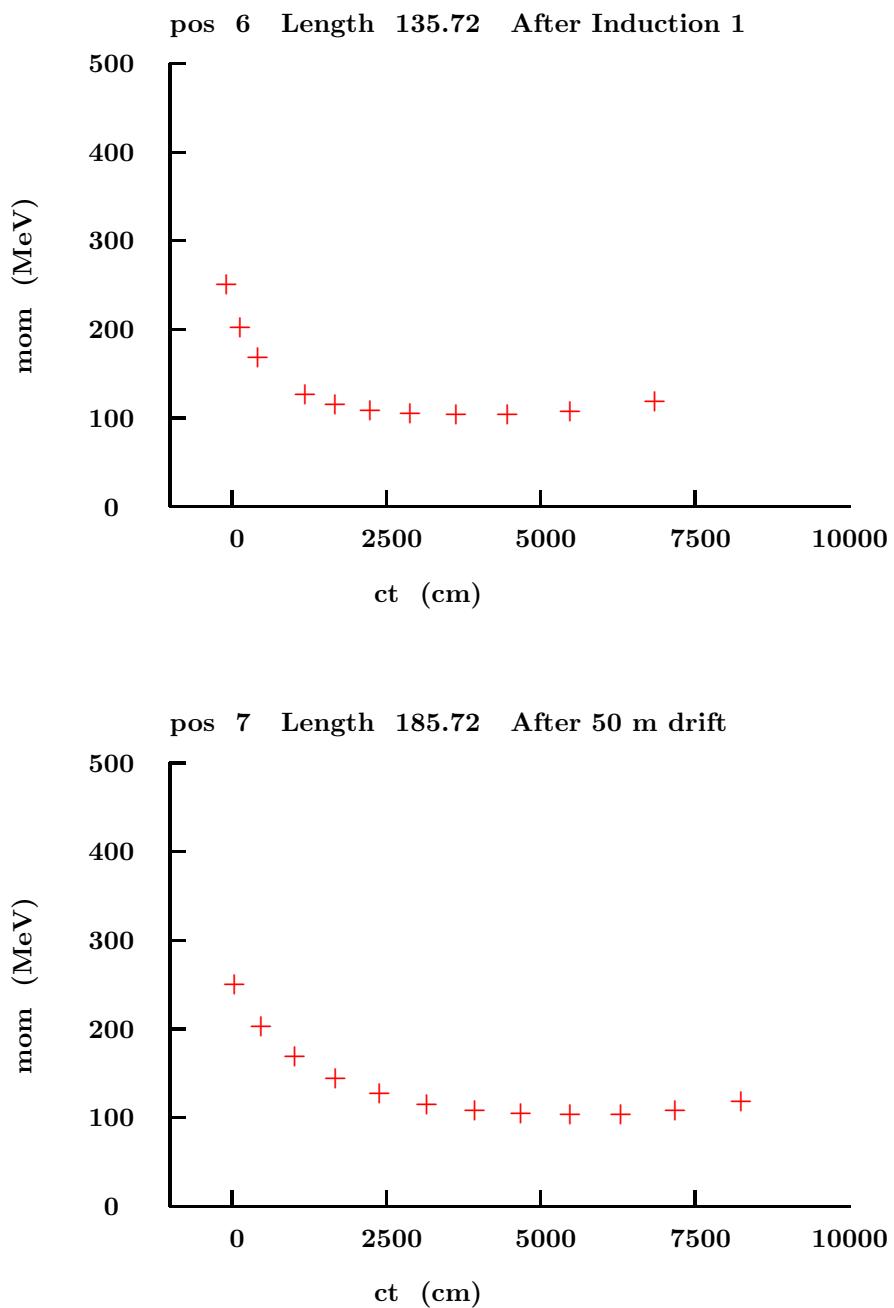


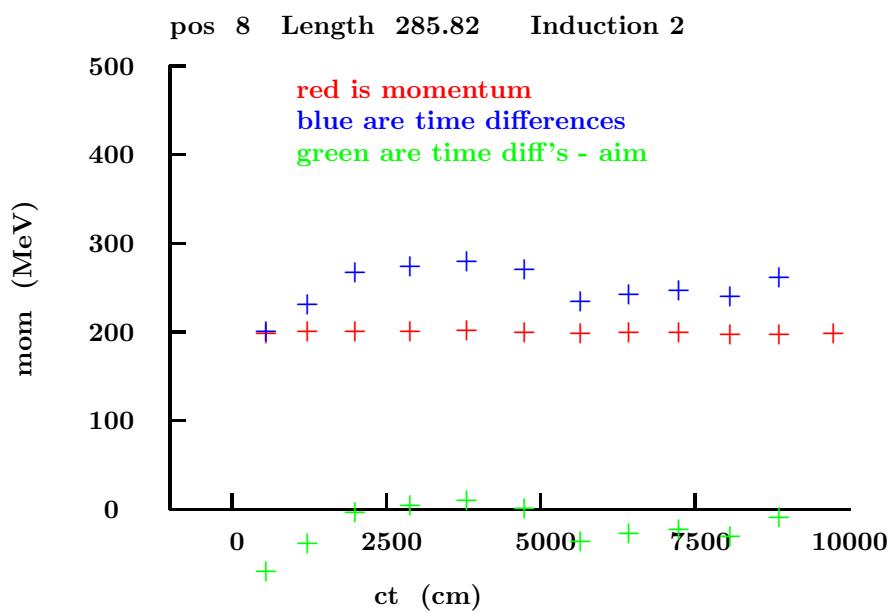
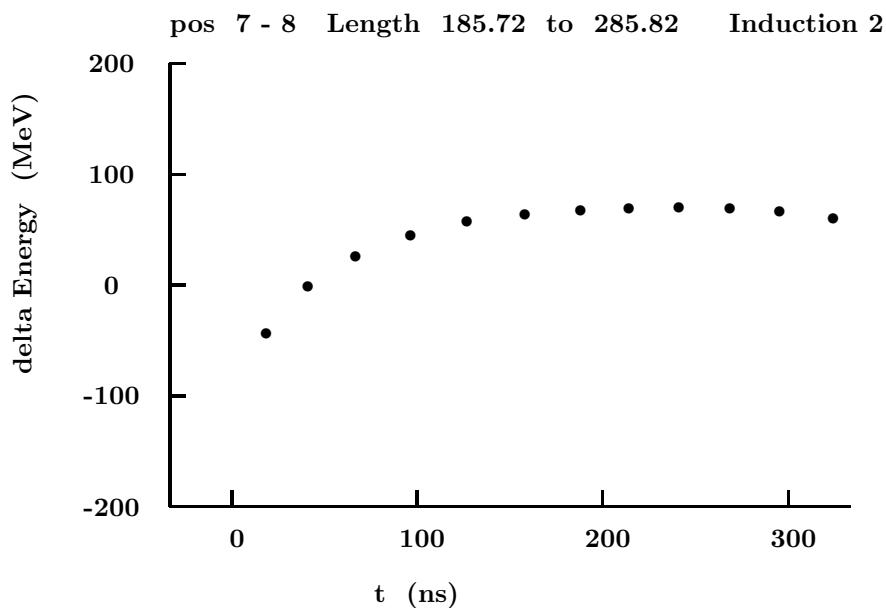
2.2 Procedure

1.
 - Set up icool with first induction, plus a drift to the approximate center of where the second induction will be.
 - Allow no decays.
 - generate, and track, ≈ 10 initial muons spaced evenly in energy, and $t=0$
 - calculate the differences (dt_i) between consequative arrival times
 - calculate a $\chi_1 = \text{rms of } (dt_i - dt_{aim})$, where $dt_{aim} = \text{the required final time spread } (\approx 300 \text{ ns}) \text{ divided by the number of tracks } (\approx 10)$
 - Using a minimizer (amoeba), adjust waveform of linac 1 to minimize χ_1 .
2.
 - add the second linac to icool
 - calculate a $\chi_2 = \text{rms of } (p_i - p_{aim})$, where $p_{aim} = \text{the required final momentum } (\approx 200 \text{ MeV})$
 - Using a minimizer (amoeba), adjust waveform of second linac to minimize χ_2 .
3. repeat 1, but with the second linac in place.
4. Repeat step 2
5.
 - generate, and track, ≈ 50 initial pions spaced evenly in energy, and $t=0$
 - allow decays, but decays constrained to 90 deg in their center of mass (DECLEV=2).
 - repeat step 2
6.
 - use ≈ 100 initial pions from a MARS file
 - install the 20 T capture and taper in ICOOL.
 - allow real decays
 - manually adjust the linac 2 waveform to correct the final muon energy distribution.

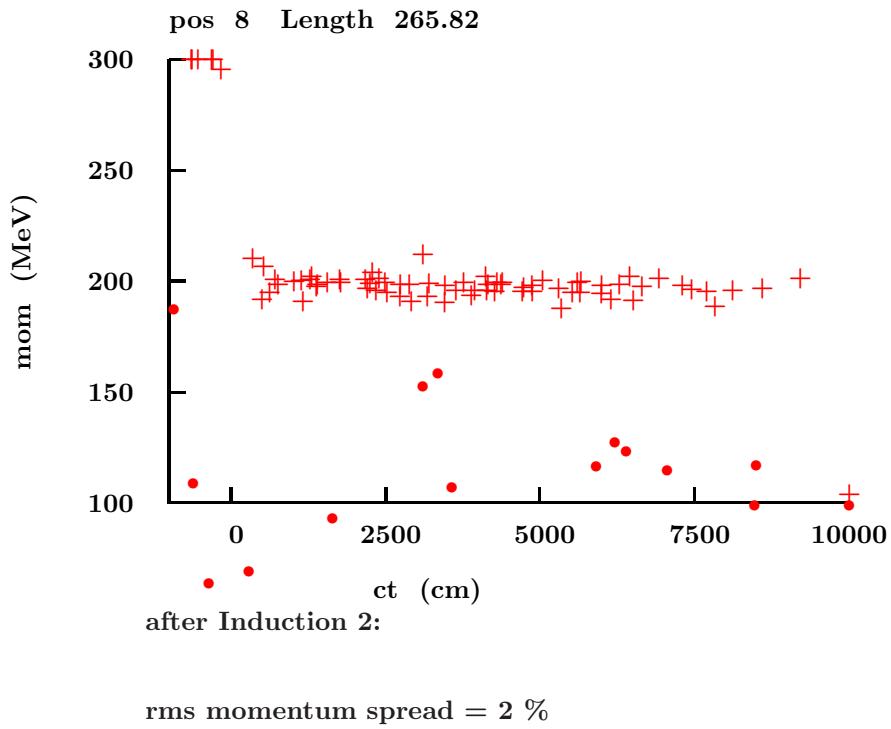
2.3 no decays or amplitude





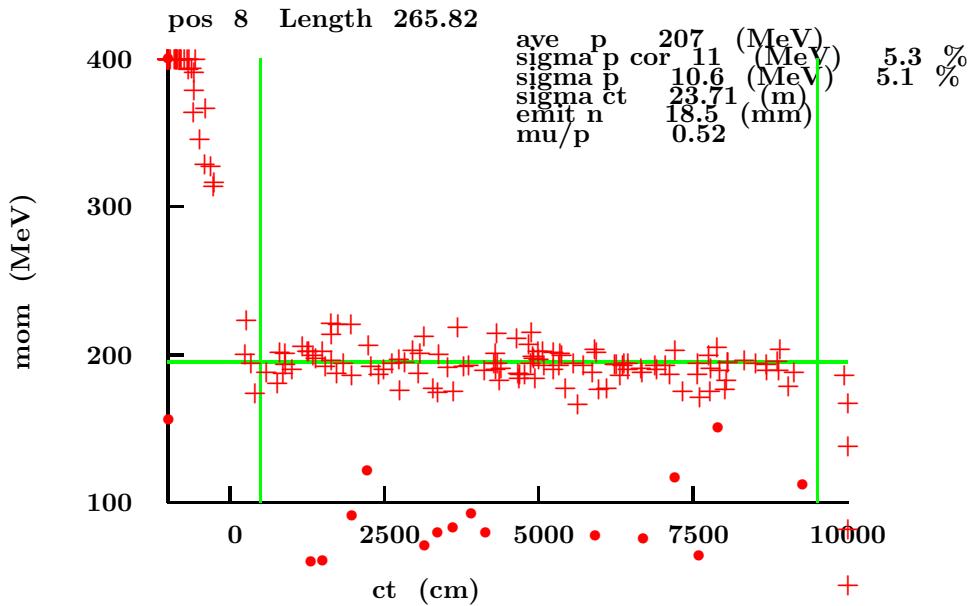


2.4 decays but no amplitude



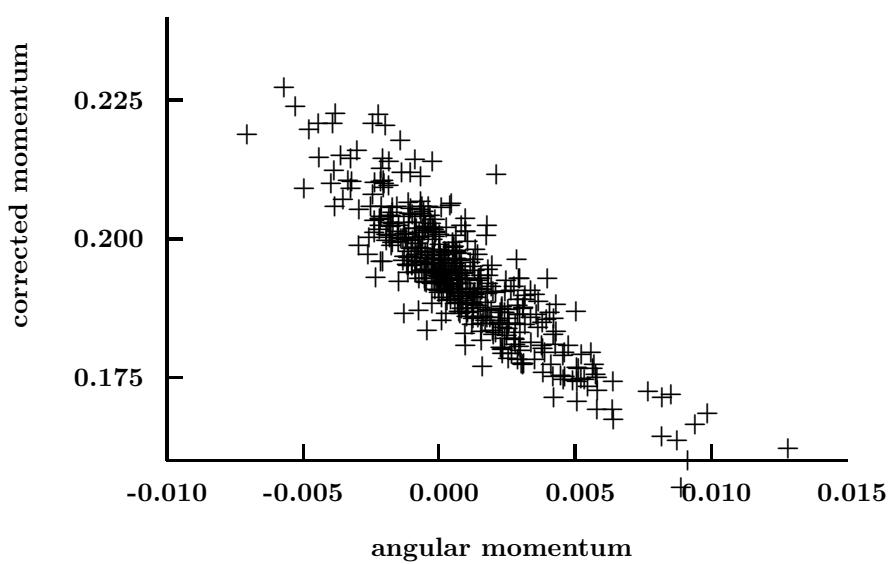
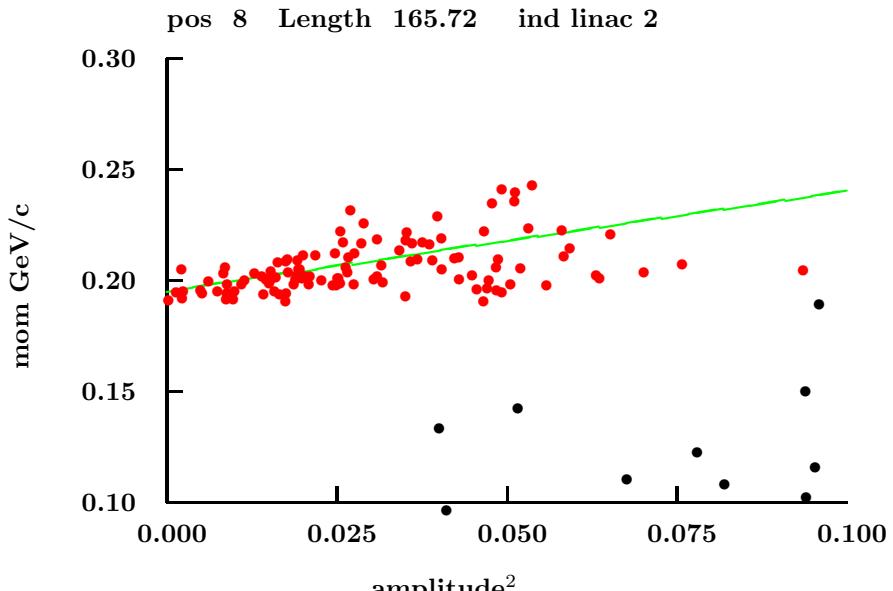
2.5 with amplitude, but no flip

After Induction 2:



Momentum spread is much worse than old double phase rotation (5 % vs 3.5 %). and that had a distorting second rotation.

Look at correlations:



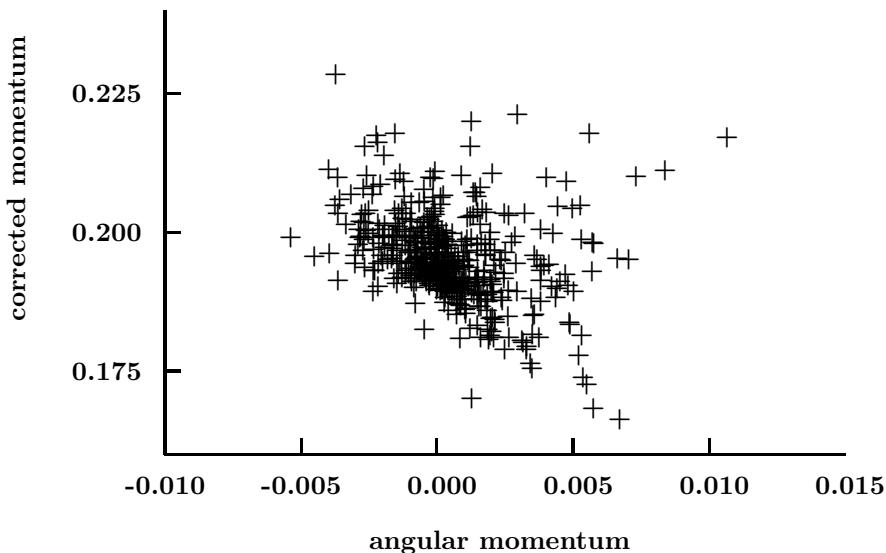
2.6 with field flip

Vary position of flip to minimize correlation:

z pos of flip m	slope rel	dp/p %	corr dp/p %	mu/p	emit mm rad
	6	5.1	5.3	.52	18.5
150	4	4.7	4.0	.50	17.6
130	2	4.9	3.9	.49	18.0
110	1	5.0	3.8	.46	18.1

Slope can be fully removed, but transmission is falling.

select to flip at 130 m



compare with double phase rotation

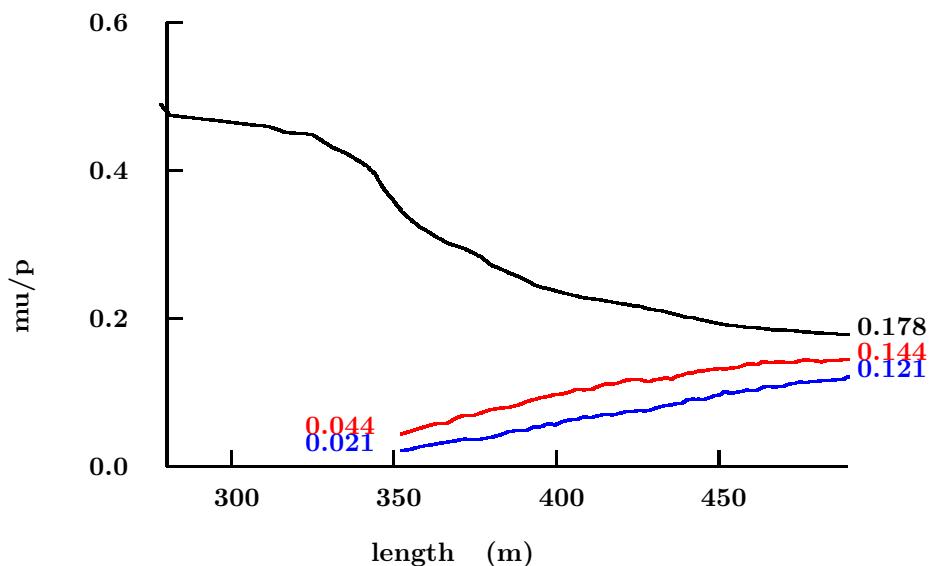
	dp/p %	corr dp/p %	mu/p	emit mm rad
this case	4.9	3.9	.49	18.0
double rot	4.7	3.7	.45	15.4

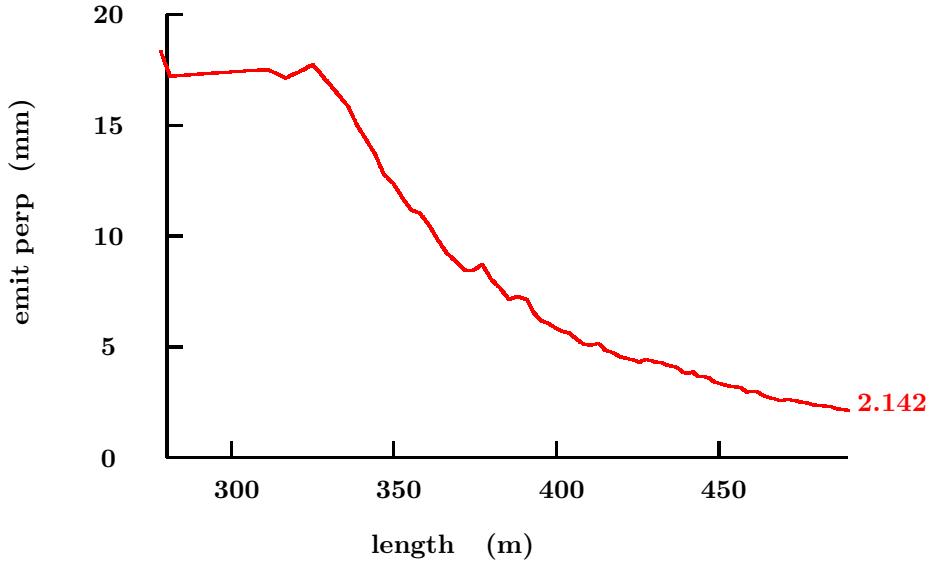
emittance is worse, but transmission better.

2.7 [icool](#)

An ICOOL run was done using an older pion source deck that had a target angle of 150 mrad. Juan has shown that this gives 12 % less muons per proton compared with the newer 100 mrad data. Sorry.

Using Greg's analysis with
long cut at 150 mm +
trans cuts at 9.35 mm and 15 mm :





To compare with double phase rotation, I have increased the numbers by 12 % to correct for the use of the older pion data file.

	tot mu/p	mu/p (15 mm)	mu/p (9.4 mm)	emit mm rad
this case	.178	.144	.121	2.14
this case + 12 %	.2	.16	.135	2.14
double rot	.24	.19	.16	1.84

We note that the non-distortion case is approximately 15 % worse than the old double phase rotation.

3 Non Distorting with minicool(nd3)

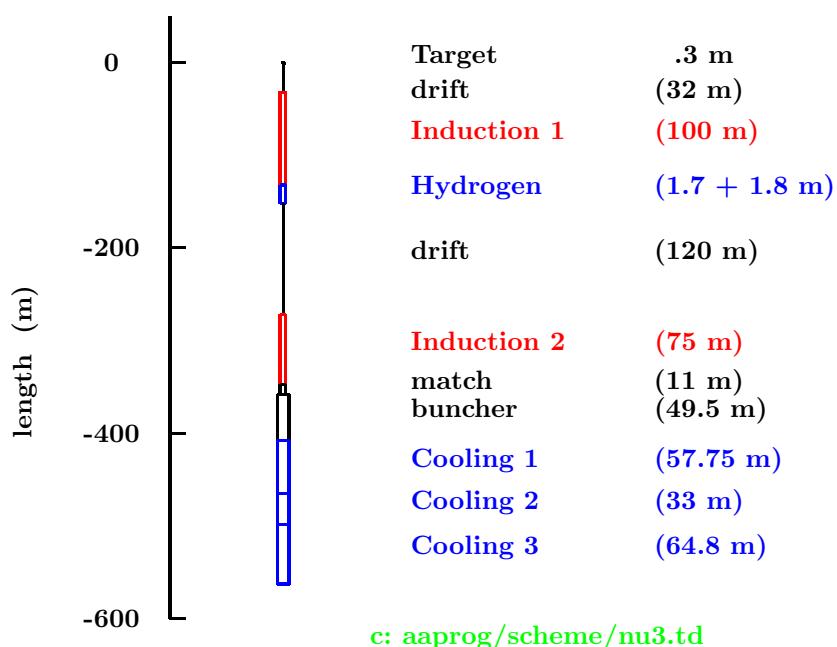
3.1 Introduction

Still:

No low frequency RF

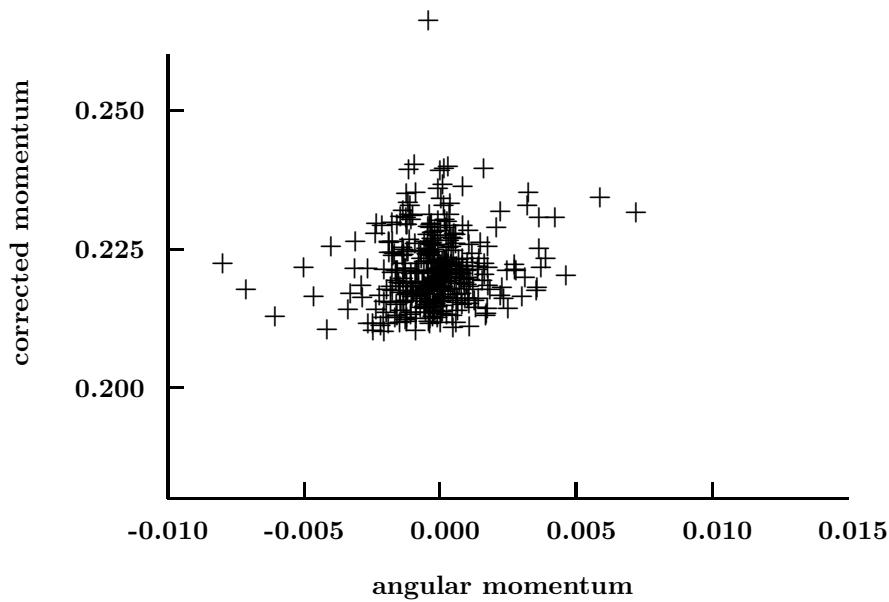
No correlation correction

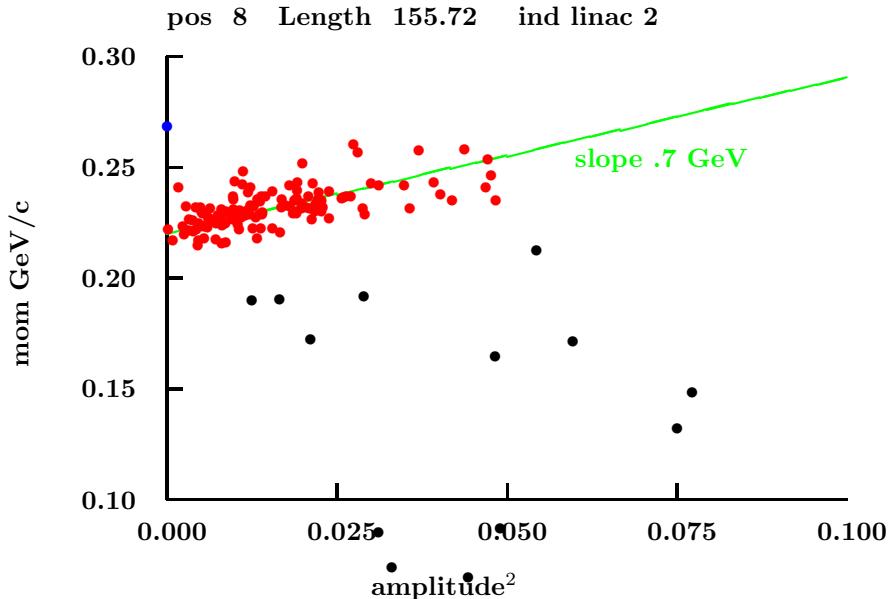
The same cooling as in my MuTAC report; i.e with tapered super FOFO, but no beta matching between different cooling sections.



3.2 with amplitude

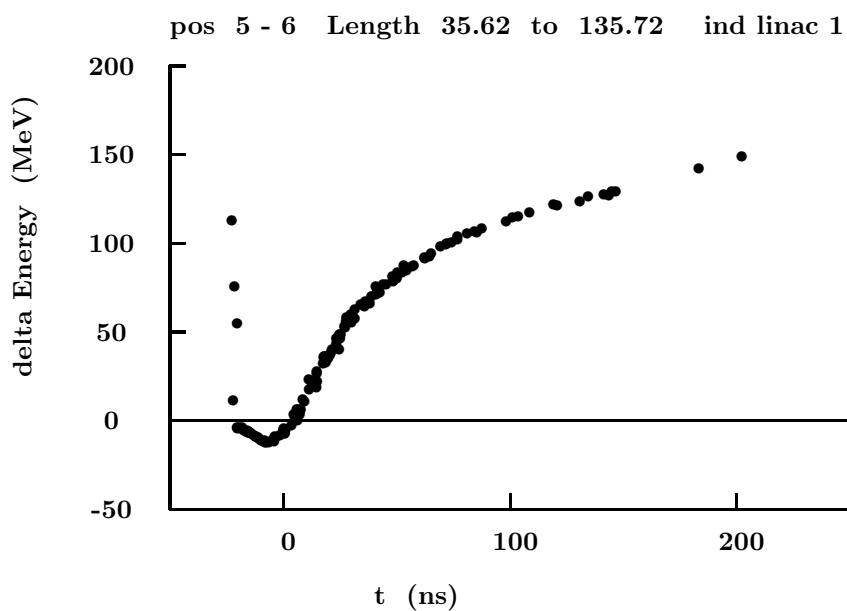
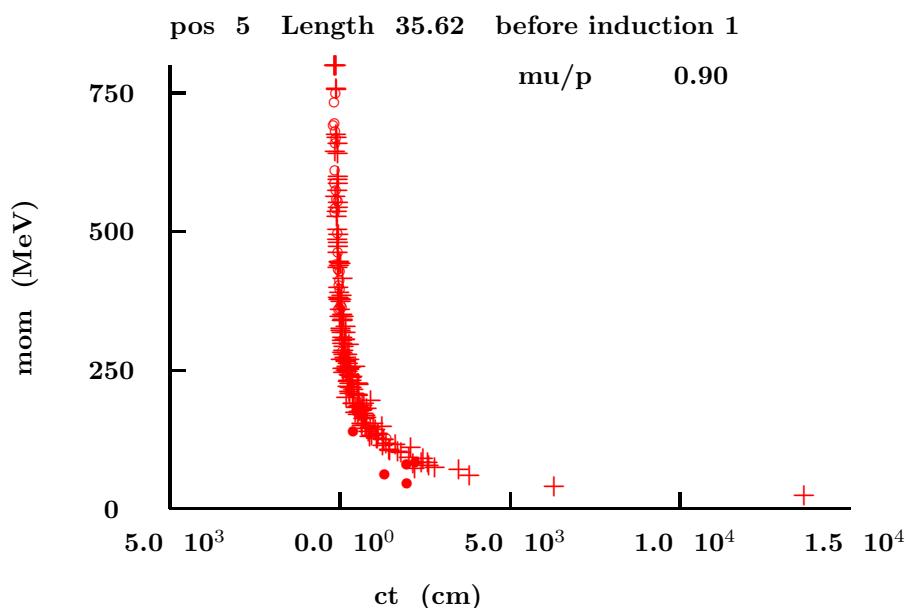
Correlations:

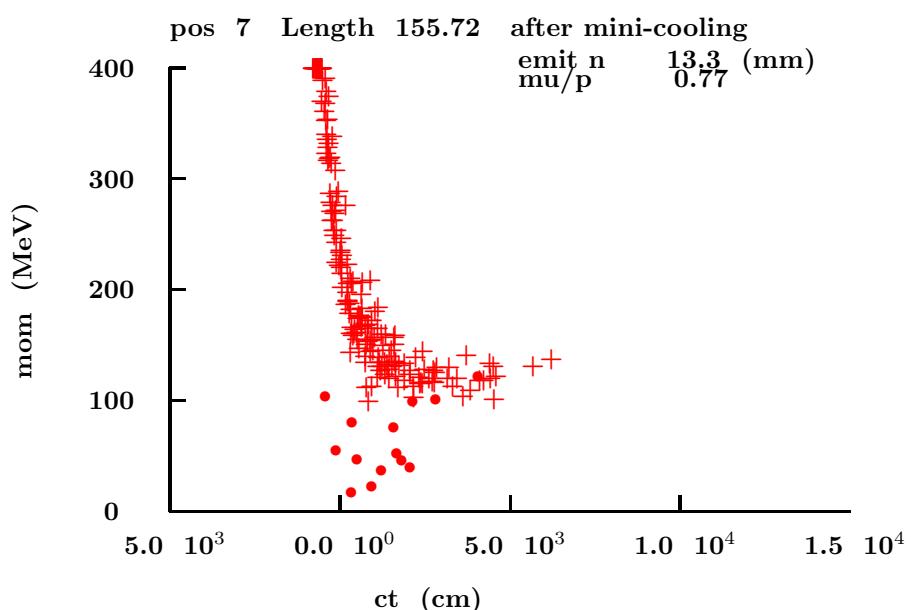
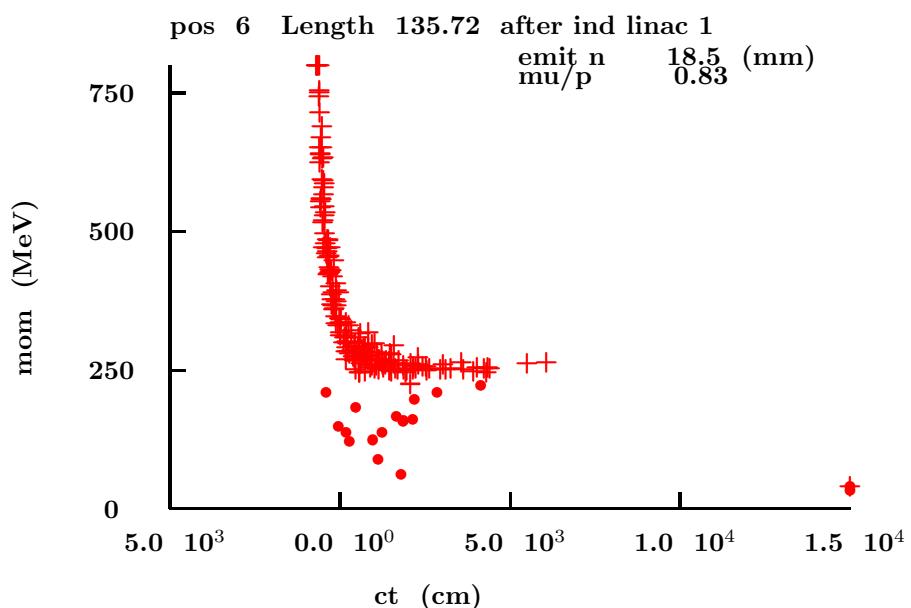


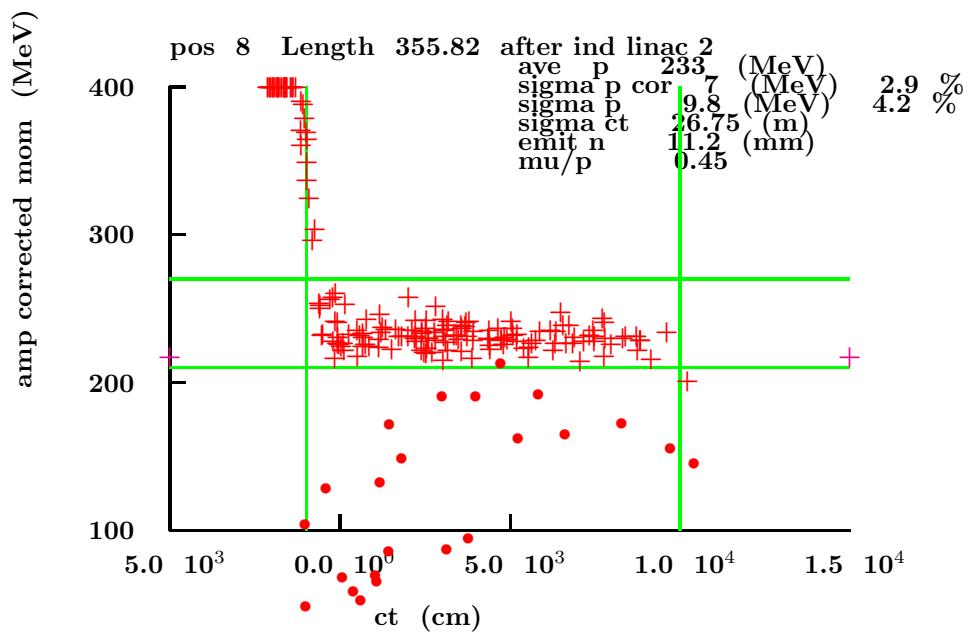
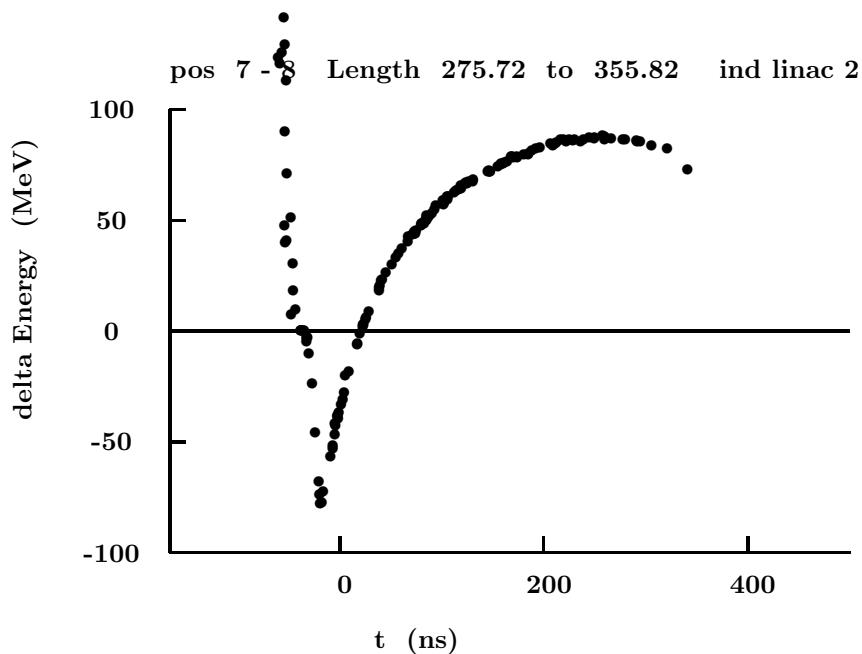


We see no momentum angular momentum correllation, so the field flip used in the minicooling seems adequate.

The momentum-amplitude correlation is seen to be 0.7. A higher value than without the minicool (.45). This is good, since it is closer to the required correllation in the cooling lattice (≈ 1.0).





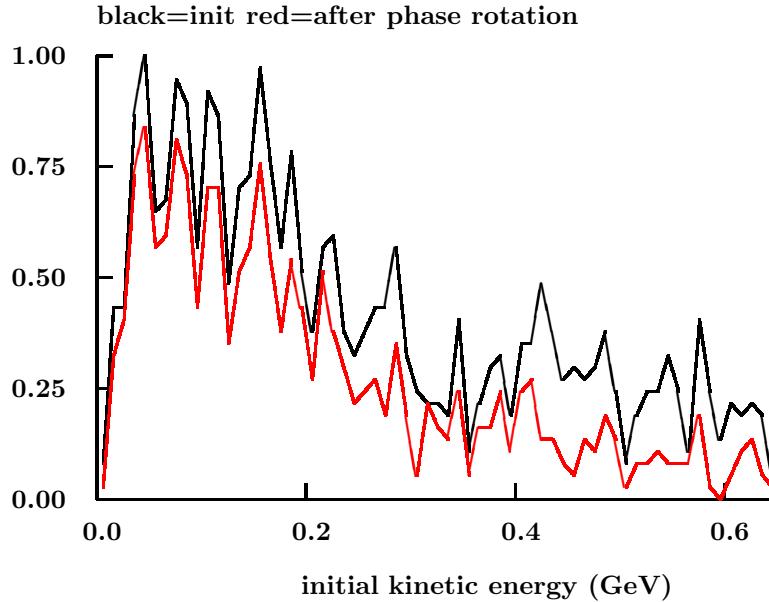


compare

	dp/p %	corr dp/p %	mu/p	emit mm rad
with minicool	4.2	2.9	.45	11.2
no mini-cool + 12 %	4.9	3.9	.54	18.0
double rot	4.7	3.7	.45	15.4

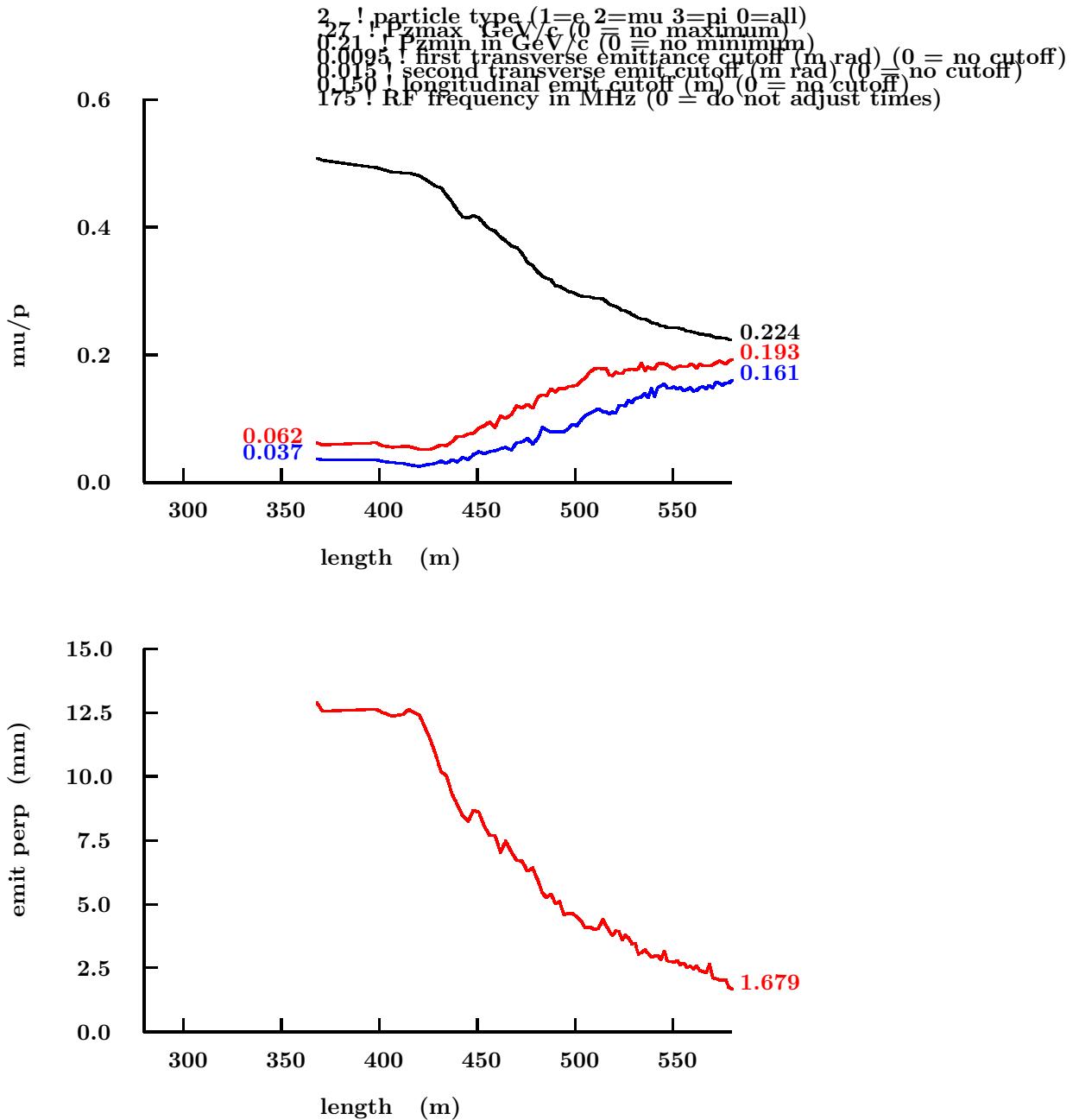
We see that we have lost some intensity but reduced the emittances in both longitudinal and transverse directions.

Efficiency of use of initial pions:



3.3 [icool](#)

Using Greg's program:



compare

	tot mu/p	mu/p (15 mm)	mu/p (9.4 mm)	emit mm rad
non-dist + minicool	.22	.19	.16	1.6
non-dist no minicool + 12 %	.2	.16	.135	2.14
double phase rot	.24	.19	.16	1.84

note: the no mini-cool numbers have been corrected for the use of the older input file

So the performance of the non-distorting case without rf is comparable with that with distortion and rf. Re-tuning the buncher should further improve it.